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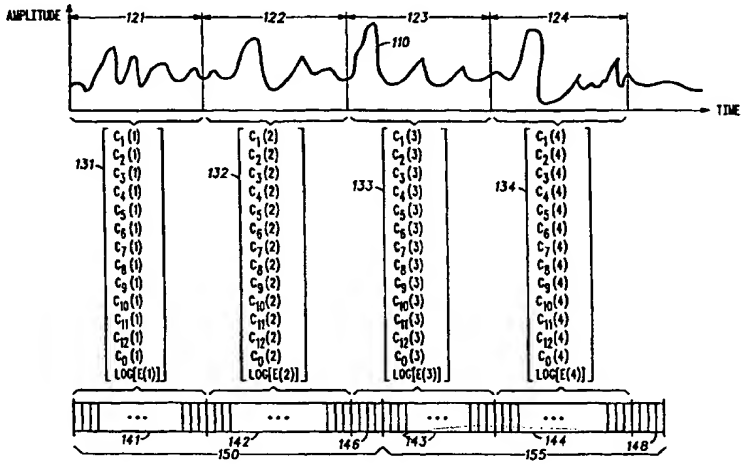

(57) Abstract

A method of mitigating errors in a distributed speech recognition process. The method comprises the steps of identifying a group comprising one or more vectors which have undergone a transmission error, and replacing one or more speech recognition parameters in the identified group of vectors. In one embodiment all the speech recognition parameters of each vector of the group are replaced by replacing the whole vectors, and each respective replaced whole vector is replaced by a copy of whichever of the preceding or following vector without error is closest in receipt order to the vector being replaced. In another embodiment determination of which speech recognition parameter or parameters are to be replaced is performed by predicting, from vectors received without error, a predicted value for each speech recognition parameter within said identified group of vectors, and replacing those speech recognition parameters within the identified group of vectors which are outside of a predetermined threshold relative to their respective predicted value. Also described is an apparatus for mitigating errors in a distributed speech recognition process.

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MITIGATING ERRORS IN A DISTRIBUTED SPEECH RECOGNITION PROCESS

Field of the Invention

The present invention relates to a method of mitigating errors in a distributed speech recognition system. The present invention also relates to an apparatus for mitigating errors in a distributed speech recognition system. The present invention is suitable for, but not limited to, mitigating transmission errors affecting speech recognition parameters when they are transmitted over a radio communications link.

Background of the Invention

Speech recognition is a process for automatically recognising sounds, parts of words, words, or phrases from speech. Such a process can be used as an interface between man and machine, in addition to or instead of using more commonly used tools such as switches, keyboards, mouse and so on. A speech recognition process can also be used to retrieve information automatically from some spoken communication or message.

Various methods have been evolved, and are still being improved, for providing automatic speech recognition. Some methods are based on extended knowledge with corresponding heuristic strategies, others employ statistical models.

In typical speech recognition processes, the speech to be processed is sampled a number of times in the course of a sampling time-frame, for example 50 to 100 times per second. The sampled values are processed using algorithms to provide speech recognition parameters. For example, one type of speech recognition parameter consists of a coefficient known as a mel cepstral coefficient. Such speech recognition parameters are arranged in the form of vectors, also known as arrays, which can be considered as groups or sets of parameters arranged in some degree of order. The sampling process is repeated for further sampling time-frames. A typical format is for one vector to be produced for each sampling time-frame.

The above parameterisation and placing into vectors constitutes what can be referred to as the front-end operation of a speech recognition process. The above

described speech recognition parameters arranged in vectors are then analysed according to speech recognition techniques in what can be referred to as the back-end operation of the speech recognition process. In a speech recognition process where the front-end process and the back-end process are carried out at the same location or in the same device, the likelihood of errors being introduced into the speech recognition parameters, on being passed from the front-end to the back-end, is minimal.

However, in a process known as a distributed speech recognition process, the front-end part of the speech recognition process is carried out remotely from the back-end part. The speech is sampled, parameterised and the speech recognition parameters arranged in vectors, at a first location. The speech recognition parameters are quantified and then transmitted, for example over a communications link of an established communications system, to a second location. Often the first location will be a remote terminal, and the second location will be a central processing station. The received speech recognition parameters are then analysed according to speech recognition techniques at the second location.

Many types of communications links, in many types of communications systems, can be considered for use in a distributed speech recognition process. One example is a conventional wireline communications system, for example a public switched telephone network. Another example is a radio communications system, for example TETRA. Another example is a cellular radio communications system. One example of an applicable cellular communications system is a global system for mobile communications (GSM) system, another example is systems such as the Universal Mobile Telecommunications System (UMTS) currently under standardisation.

The use of any communications link, in any communications system, causes the possibility that errors will be introduced into the speech recognition parameters as they are transmitted from the first location to the second location over the communications link.

It is known to provide error detection techniques in communications systems such that the presence of an error in a given portion of transmitted information is detectable. One well known technique is cyclic redundancy coding.

When the presence of an error is detected, different mitigating techniques are employed according to the nature of the information transmitted. Techniques of error mitigation applied to other forms of information are not particularly suited to mitigating errors in speech recognition parameters, due to the specialised speech recognition techniques the parameters are subjected to, and hence it is desirable to provide means for mitigating errors in a distributed speech recognition process.

Summary of the Invention

The present invention provides a means to mitigate the effect of transmission errors such as those described above.

According to one aspect of the present invention, there is provided a method of mitigating errors in a distributed speech recognition system, as claimed in claim 1.

According to another aspect of the invention, there is provided an apparatus for mitigating errors in a distributed speech recognition system, as claimed in claim 13.

Further aspects of the invention are as claimed in the dependent claims.

The present invention tends to provide means for mitigating errors which are particularly appropriate to the nature of a distributed speech recognition process, the properties of the speech recognition parameters employed therein and the vectors in which they are arranged.

More particularly, the possibility of allowing latency in a speech recognition process is advantageously exploited when, according to one aspect of the present invention, one or more speech recognition parameters in an identified group of vectors are replaced by respective replacement parameters determined

by reference to one or more speech recognition parameters from a vector received after the identified group of vectors.

Furthermore, when according to another aspect of the present invention determination of which speech recognition parameter or parameters are to be replaced is performed by predicting, from vectors received without error, a predicted value for each speech recognition parameter within said identified group of vectors, and replacing those speech recognition parameters within the identified group of vectors which are outside of a predetermined threshold relative to their respective predicted value, then the effect is to advantageously exploit the independent relationship in the errors between different parameters within a speech recognition vector.

Additional specific advantages are apparent from the following description and figures.

Brief Description of the Drawings

FIG. 1 is a schematic illustration of speech recognition parameters arranged in vectors corresponding to sampling time-frames of an embodiment of the present invention.

FIG. 2 is a process flow chart of an embodiment of the present invention.

FIG. 3 is a schematic illustration of consecutively received vectors of an embodiment of the present invention.

Description of Embodiments of the Invention

In the exemplary embodiments described below, the speech recognition parameters are arranged in vectors corresponding to sampling time-frames as shown schematically in FIG. 1.

A portion of speech signal 110 to be processed is shown in FIG. 1. Speech signal 100 is shown in greatly simplified form, since in practise it will consist of a much more complicated sequence of sample values.

Sampling time-frames, of which in FIG. 1 are shown a first sampling time-frame 121, a second sampling time-frame 122, a third sampling time-frame 123 and a fourth sampling time-frame 124, are imposed upon the speech signal as shown in FIG. 1. In the embodiment described below there are 100 sampling time-frames per second. The speech signal is sampled repeatedly in the course of each sampling time-frame.

In the embodiments described below, the speech recognition process is one in which a total of fourteen speech recognition parameters are employed. The first twelve of these are the first twelve static mel cepstral coefficients, i.e.

$$\mathbf{c}(m) = [c_1(m), c_2(m), \ldots, c_{12}(m)]^T,$$

where m denotes the sampling time-frame number. The thirteenth speech recognition parameter employed is the zeroth cepstral coefficient, i.e. $c_0(m)$. The fourteenth speech recognition parameter employed is a logarithmic energy term, i.e. log[E(m)]. Details of these coefficients and their uses in speech recognition processes are well known in the art and do not require further description here. Moreover, it is noted that the invention can be carried out with other combinations of cepstral coefficients forming the speech recognition parameters, likewise with other choices or schemes of speech recognition parameters other than cepstral coefficients.

The fourteen parameters for each sampling time-frame are arranged, or formatted, into a corresponding vector, also known as an array, as shown in FIG. 1. Vector 131 corresponds to sampling time-frame 121, vector 132 corresponds to sampling time-frame 122, vector 133 corresponds to sampling time-frame 123, and vector 134 corresponds to sampling time-frame 124. Such a vector can generally be represented as

$$y(m) = \begin{bmatrix} \mathbf{c}(m) \\ c_0(m) \\ \log[E(m)] \end{bmatrix}.$$

The speech recognition parameters are processed prior to transmission from a first location to a second location. In the embodiment described below this is carried out as follows. The parameters from vector 131 are quantized. This is implemented by directly quantizing the vector with a split vector quantizer. Coefficients are grouped into pairs, and each pair is quantized using a vector quantization (VQ) codebook predetermined for that respective pair. The resulting set of index values is then used to represent the speech frame. Coefficient pairings, by front-end parameter are as shown in Table 1, along with the codebook size used for each pair.

TABLE 1

Split Vector Quanization Feature Pairings

Codebook	Size	Weight Matrix ($W^{i,i+1}$)	Element 1	Element 2
$Q^{0,1}$	64	I	c_1	c_2
$Q^{2,3}$	64	I	c_3	c_4
$Q^{4,5}$	64	I	c_5	c_6
$Q^{6,7}$	64	I	c_7	c_8
$Q^{8,9}$	64	I	c_9	c_{10}
$Q^{10,11}$	64	I	c_{11}	c_{12}
$Q^{12,13}$	256	non – identity	c_0	$\log[E]$

The closest VQ centroid is found using a weighted Euclidian distance to determine the index,

$$d_j^{i,i+1} = \begin{bmatrix} y_i(m) \\ y_{i+1}(m) \end{bmatrix} - q_j^{i,i+1}$$

$$idx^{i,i+1}(m) = \underset{0 \le j \le (N^{i,i+1}-1)}{\text{argmin}} \{(d_j^{i,i+1})^t W^{i,i+1} (d_j^{i,i+1})\}, \quad i = 0,2,4,\ldots 12$$

where $q_j^{i,i+1}$ denotes the jth codevector in the codebook $Q^{i,i+1}$, $N^{i,i+1}$ is the size of the codebook, $W^{i,i+1}$ is the (possibly identity) weight matrix to be applied for the codebook $Q^{i,i+1}$, and $idx^{i,i+1}(m)$ denotes the codebook index chosen to represent the vector $[y_i(m), y_{i+1}(m)]^T$.

The indices that are produced are then represented in the form of 44 bits. These 44 bits are placed in the first 44 slots, as shown by reference numeral 141 in FIG. 1, of a bit stream frame 150. The corresponding 44 bits produced for the following vector, namely vector 132, are placed in the next 44 slots, as shown by reference numeral 142 in FIG. 1, of the bit stream frame 150. The remaining bits of the bit stream frame 150 consist of 4 bits of cyclic redundancy code, as shown by reference numeral 146 in FIG. 1, the value of the bits being determined such as to provide error detection, in a known fashion, for the whole of the 88 preceding bits of the bit stream frame 150. Similarly, the 44 bits provided from vector 133 are placed in the first 44 slots, as shown by reference numeral 143 in FIG. 1, of a second bit stream frame 155. Also, the corresponding 44 bits produced for the following vector, namely vector 134, are placed in the next 44 slots, as shown by reference numeral 144 in FIG. 1, of the bit stream frame 155. The remaining bits of the bit stream frame 155 consist of 4 bits of cyclic redundancy code, as shown by reference numeral 148 in FIG. 1. This arrangement is repeated for following vectors. The above described format of the bit stream frames, in which bit data from two vectors is arranged in a single combined bit stream frame, is merely exemplary. For example, each vector's data could instead be arranged in a single bit stream frame containing its own error detection bits. Similarly the number of slots per bit stream frame is merely exemplary.

For the sake of avoiding any confusion, it is pointed out that the bit stream frames described above should not be confused with transmission frames that are then used in the transmission of the bit stream data over the communications link of the communications system in which the data is transmitted from a first location to a second location, for example the time division multiple access (TDMA) time frames of a GSM cellular radio

communications system, which is the communications system employed in the embodiments herein described. In the present example the first location consists of a remote user station, and the second, i.e. receiving location, consists of a centralised processing station, which can be located for example at a base station of the cellular communications system. Hence in the embodiments herein described the speech recognition parameters are transmitted from the first location to the second location over a radio communications link. However, it is to be appreciated that the nature of the first location and the second location will depend upon the type of communications system under consideration and the arrangement of the distributed speech recognition process therein.

The bit stream frames are reconstituted from their transmission format at the second location after being received there.

Thus, above is described a distributed speech recognition process in which speech recognition parameters are arranged in vectors corresponding to sampling time-frames and said speech recognition parameters are received at a second location having been transmitted from a first location. The method of mitigating errors in such a speech recognition process according to a first embodiment is shown in process flow chart 200 of FIG. 2. Referring to FIG. 2, function box 210 shows the step of identifying a group comprising one or more of said vectors which have undergone a transmission error. In the present embodiment error detection is carried out by comparing the 4 cyclic redundancy coding bits such as 146, 148 with the contents of the respective bit stream frames 150, 155, using known cyclic redundancy code methods. This will identify, in the present example, any single bit stream frame that has undergone a transmission error. Thus in the present example the identified group of vectors consists of two vectors, that is the pair of vectors from the single bit stream frame. If, in another example, each bit stream frame with error detection means contained only one vector, then the identified group of vectors would be a single vector. It is to be appreciated that the exact form and technical reason determining how many vectors are in such an identified group will depend on the different ways in which the vectors have been arranged in bit streams, and moreover how an error detection method has been imposed on top of that. Particularly, error detection methods other than the cyclic redundancy coding employed in the present embodiment might provide other numbers of vectors in an identified

group. Also, for any given bit stream arrangement, subsidiary design choices of how to process the error information can also play a role in determining the number of vectors in an identified group. For example, with reference to the present embodiment, it could be decided for reasons of conserving processing power to only consider whether batches of bit stream frames contain an error, even if the error detection means were physically capable of more narrowly detecting the error.

The speech recognition parameters are retrieved from the bit stream frames by carrying out a reverse version of the vector quantization procedure described above. More particularly, indices are extracted from the bit stream, and using these indices, vectors are reconstituted in the form

$$\begin{bmatrix} \hat{y}_i(m) \\ \hat{y}_{i+1}(m) \end{bmatrix} = q^{i,i+1}_{idx^{i,i+1}}(m) \qquad i = 0,2,4,....,12$$

Function box 220 shows the next step of the present embodiment, namely the step of replacing one or more speech recognition parameters in the identified group of vectors. In the present embodiment the order of the different processing steps is carried out such that all of the received speech recognition parameters are retrieved from the bit stream frames and temporarily stored, prior to replacement of one or more speech recognition parameters. However, it is noted that the one or more speech recognition parameters could alternatively be replaced by altering the bit stream information in a corresponding fashion before actually physically retrieving the speech recognition parameters, including the newly introduced replacement ones, from the bit stream format.

In the following description of how replacement speech recognition parameters are determined, reference is made to FIG. 3 which shows vectors 131-134 as already described with reference to FIG. 1 plus a further 6 vectors 135-140 received consecutively thereafter. In the present embodiment the one or more speech recognition parameters in said identified group of vectors are replaced by respective replacement parameters determined by reference to one or more speech recognition parameters from a vector received after said identified group of vectors. Thus, in the present embodiment, when an error is detected

for bit stream frame 155, and thus the group consisting of vectors 133 and 134 is identified, then one or more of the speech recognition parameters in vectors 133 and 134 is replaced by respective replacement parameters determined by reference to one or more speech recognition parameters from one of vectors 135-140 or a vector received after vector 140 and not shown in FIG. 3. It is noted that determination with reference to such following vectors does not rule out the possibility that reference to preceding vectors such as 131, 132 or others not shown is also included in the determination process.

Such reference to vectors received after the identified group of vectors provides a method which can be performed particularly effectively with respect to speech recognition, because the latency can be exploited advantageously to provide better performance from the back-end speech recogniser. To apply such methods involves the temporary storage of received vectors in a buffer before output to the back-end. The vectors received after the identified group of vectors are used to compute replacement values. There will therefore be an increase in the latency before the error mitigated vectors can be made available to the back-end. This latency will usually not be a problem for the back-end recogniser which, especially if it is part of a centralised server, will have sufficient computational resources to overcome temporary fluctuations in latency caused by such error mitigation methods.

More particularly, in the present embodiment all the speech recognition parameters of each vector of said group are replaced by replacing the whole vectors, and each respective replaced whole vector is replaced by a copy of whichever of the preceding or following vector without error is closest in receipt order to the vector being replaced. Since for the presently described mode of transmission and mode of error detection the group of identified vectors consists of a pair of consecutive vectors, then the first vector of said pair is replaced by the second vector of a preceding vector without error and the second vector of said pair is replaced by the first vector of a following vector without error. In the present case, if for example vectors 135 and 136 are identified as a pair of vectors having an error, the whole of vector 135 is replaced by a copy of vector 134, and the whole of vector 136 is replaced by a copy of vector 137, provided that vectors 134 and 137 are not themselves parts of pairs that have been identified as having undergone a transmission error. If,

say, the pair of vectors 133 and 134 are indeed themselves also a pair of vectors with an error, then both vectors 135 and 136 will be replaced by a copy of vector 137, the first known correct vector following them, because it is closer in receipt order to each of them than vector 132 which is the nearest known correct vector preceding them. In the latter scenario, vectors 133 and 134 will both be replaced by copies of vector of 132, this being the vector closest in receipt order from amongst those vectors known to be correct.

In an alternative version of the present embodiment wherein whole vectors are replaced, instead of simply using copies of preceding or following of received vectors that are known to be correct, each respective replaced whole vector is replaced by a vector determined by means of an interpolation technique. The skilled person will choose an appropriate interpolation technique according to the requirements of the particular speech recognition process under consideration. Examples of interpolation methods that can be employed are the following:

(i) linear interpolation – under this method, for each parameter the values taken from one or more vectors before and after the vectors known to contain errors are used to determine a constant and gradient defining a straight line equation between them. The interpolated values which are used to replace each parameter in the vectors with errors are then calculated using the equation for the lines.

(ii) backwards prediction - this method involves taking one or more unerrored vectors after the vectors known to contain errors. For each parameter the replacement value is generated from a weighted sum of these vector elements in the sequence of vectors, this method being known as prediction. The weights are predetermined by training on the parameters of vectors from speech without errors.

(iii) curve fitting - this method involves taking one or more vectors before and after the vectors known to contain errors. This method is similar to linear interpretation, but instead of fitting to a straight line, fitting is instead carried out using a curve based on the good parameters and using the equation of the curve to create the replacement values for each parameter.

In the above embodiments, the speech recognition parameters were replaced by way of replacing whole vectors. However, in further embodiment of the present invention, as described below, not all the speech recognition parameters within a vector are necessarily replaced.

In the embodiment hereinafter described, determination of which speech recognition parameter or parameters are to be replaced is performed by predicting, from vectors received without error, a predicted value for each speech recognition parameter within said identified group of vectors, and replacing those speech recognition parameters within the identified group of vectors which are outside of a predetermined threshold relative to their respective predicted value.

Consider the case when vectors 133 and 134 are identified as a pair of vectors having an error. A predicted value is determined for each of the speech recognition parameters $c_1(3)$, $c_2(3)$,...., $c_{12}(3)$, $c_0(3)$, and log[E(3)] of vector 133 and for each of the speech recognition parameters $c_1(4)$, $c_2(4)$,...., $c_{12}(4)$, $c_0(4)$, and log[E(4)] of vector 134. The predicted value is determined by any suitable prediction method. For example, prediction techniques described above with respect to whole vectors, such as linear interpretation, backwards prediction and curve fitting, can be applied to individual speech recognition parameters. When applied to individual speech recognition parameters, the correspondingly positioned parameters within the other vectors are used, e.g. in the case of calculating a predicted value for $c_1(3)$, the values of corresponding position speech recognition parameters $c_1(1)$, $c_1(2)$, $c_1(5)$, $c_1(6)$, and so on, are used.

Thus in the present embodiment the independent relationship between different parameters within a speech recognition vector is advantageously exploited.

A predetermined threshold relative to the predicted value is employed. The threshold level is set according to the requirements of the particular process under consideration. It can be altered over time based on experience gained within the process under consideration or other processes, or trials or

simulations or the like. The threshold level can also be varied automatically on an ongoing feedback basis. For example, it can be varied according to the level of errors being identified. The threshold level can also be a function of the predicted value. The threshold level can also be varied as a function of which speech recognition parameter, i.e. whether the parameter is $c_1(m)$ or $c_2(m)$ or $c_3(m)$ and so on, which is particularly advantageous when the invention is applied to speech recognition processes in which certain speech recognition parameters are more important to the success of the speech recognition process than others. This is indeed the case in the present example, where the speech recognition process is more sensitive to the middle order mel cepstral coefficients such as $c_3(m)$, $c_4(m)$ and $c_5(m)$ than to the higher order ones such as $c_{10}(m)$, $c_{11}(m)$ and $c_{12}(m)$.

In one version of the present embodiment, if more than a specified number of speech recognition parameters within said identified group of vectors are outside of their respective predetermined thresholds then all the speech recognition parameters of said identified group of vectors are replaced. In the present case, if more than 4 speech recognition parameters from any of the 28 speech recognition parameters contained within vectors 133 and 134 are outside of their respective predetermined thresholds then all the speech recognition parameters of vectors 133 and 134 are replaced. The choice of the specified number is made according to the requirements of the particular speech recognition process under consideration. By replacing the whole vectors in this way, there is an advantageous tendency to eliminate speech recognition parameters which are likely to be in error even though they have fallen within the level of the above described thresholds.

In the present embodiment, the speech recognition parameters are replaced by the respective predicted values used in the step of determining which speech recognition parameters are to be replaced. This is efficient in that these values have already been determined.

In another version of the present embodiment, those speech recognition parameters which are within a predetermined threshold relative to their respective predicted value are compared with a set of reference vectors to find a best match vector from said set of reference vectors, and those speech

recognition parameters which are outside of a predetermined threshold relative to their respective predicted value are replaced by corresponding speech recognition parameters from said best match vector.

Again consider the case when vectors 133 and 134 are identified as a pair of vectors having an error. Further consider that the only speech recognition parameter from the two vectors to be determined out of threshold range is $c_1(3)$ from vector 133. Then using a correlation technique the closest fit between the remainder of vector 133 and a set of reference vectors is determined.

Within the set of reference vectors, the number of reference vectors and the contents thereof are chosen according to the requirements of the particular speech recognition process under consideration. These choices will involve a trade-off between accuracy and sensitivity of the error correction compared to levels of processing required. The criteria for determining which reference vector represents the best fit, to the remaining parts of a vector after the out of threshold parameters are discounted, is also implemented according to the requirements of the particular speech recognition process under consideration. Known correlation techniques are employed, such as computing the Euclidian distance. How they are adapted to the present method is that only the vector elements that are within the threshold are included in the calculation of the distance.

In another version of the present embodiment, speech recognition parameters from one or more neighbouring vectors are also compared with the set of reference vectors and the best match with respect to a plurality of consecutive reference vectors is chosen. Again consider the case when vectors 133 and 134 are identified as a pair of vectors having an error, and further that the only speech recognition parameter from the two vectors to be determined out of threshold range is $c_1(3)$ from vector 133. The remainder of vector 133 (i.e. speech recognition parameters $c_2(3)$, $c_3(3)$ ...., $c_{12}(3)$, $c_0(3)$, and $\log[E(3)]$) plus the whole of surrounding vectors 132 and 134 are compared *en bloc* with respect to reference groups of 3 consecutive reference vectors.

In the embodiments described above, the step of identifying a group comprising one or more of said vectors which have undergone a transmission

error consists of comparing the 4 cyclic redundancy coding bits such as 146, 148 with the contents of the respective bit stream frames 150, 155, using known cyclic redundancy code methods. However, in further embodiments of the present invention, the step of identifying a group comprising one or more of said vectors which have undergone a transmission error can include assessment of the speech recognition parameters themselves. This can be as an additional, safety-net type approach carried out as well as a conventional method such as cyclic redundancy coding, or alternatively can be used instead of conventional methods such as cyclic redundancy coding, in which this is as the sole way of identifying error groups of vectors.

In the first of such further embodiments, respective predicted values for the speech recognition parameters are determined. This is done in any one of the same ways as were described earlier above with respect to the embodiments determining which speech recognition parameters were to be replaced, although when this is being carried out as the sole means of identifying errors then of course it is not possible to include the detail included earlier above that only vectors received without error are used in the prediction calculation, other than in the sense of input to interpolation functions. One or more threshold levels relative to the predicted values are determined. This is also carried out in any of the same ways as were described earlier above with respect to the embodiments determining which speech recognition parameters were to be replaced. However, typically the thresholds employed here will be greater than those used in the earlier described situation. Also, it is noted that one or more threshold levels are determined. For example, in the case of determining two threshold levels, one can correspond to a highly likely error, whereas the other can correspond to an outside chance of an error. Then the vector groups considered to have undergone a transmission error are identified responsive to a weighted analysis of how many speech recognition parameters in a vector group are outside of each of said one or more threshold levels. For example, in the present case the weighted analysis could be such that if the highly likely error threshold is exceeded then a score of 5 is allocated, and if an outside chance of an error threshold is exceeded then a score of 1 is allocated, and the group of vectors can be identified as having undergone a transmission error if the total score is 6 or more. This is only one example of a weighted analysis scheme that can be employed, and the choice of particular scheme, including

much more intricate ones than that just described, can be used according to the requirements of the particular distributed speech recognition process under consideration.

The second of such further embodiments includes a step of determining a difference between corresponding speech recognition parameters from different vectors within a vector group. Referring to vectors 133 and 134 for example, the difference between $c_1(3)$ and $c_1(4)$ is calculated, the difference between $c_2(3)$ and $c_2(4)$ is calculated, the difference between $c_3(3)$ and $c_3(4)$ is calculated, and so on. The vector groups considered to have undergone a transmission error are identified responsive to an analysis of how many of said differences are outside of a predetermined threshold level. An appropriate predetermined threshold level is set, and can be altered over time, making use of any of the same ways as were described earlier above with respect to the embodiments determining which speech recognition parameters were to be replaced. In the present case, the group of vectors is identified as having undergone a transmission error if two or more of said calculated differences are outside of the threshold level. This choice of how many need to be outside the threshold level is merely exemplary, and will generally be chosen according to the requirements of the particular distributed speech recognition process under consideration. A further optional aspect can be applied to embodiments wherein as part of the vector qauntization process speech recognition parameters are grouped into pairs, as described earlier above with reference to Table 1. In this case, if the difference for either of the speech recognition parameters in a given codebook index is beyond the threshold then that codebook index is labelled as received with error, i.e. referring to Table 1, if either the c_3 difference or the c_4 difference is beyond the threshold then the codebook index $Q^{2,3}$ is labelled as received with error. Then if more than a given number, for example 2, of codebook indices from the 7 in a vector group are labelled as received with error, the vector group is identified as having undergone a transmission error. Clearly, when choosing the threshold levels and choosing how many differences must be outside the threshold levels, trade-off considerations will be assessed according to the requirements of the particular distributed speech recognition process under consideration.

In the case of the embodiments described above, the data processing steps described are carried out by a programmable digital signal processing device,

such as one selected from the DSP56xxx (trademark) family of devices from Motorola. Alternatively an application specific integrated circuit (ASIC) can be employed. Other possibilities also exist. For example, an interface unit can be employed that interfaces between a radio receiver and a computer system forming part of a back-end speech recognition processor.

CLAIMS

1. A method of mitigating errors in a distributed speech recognition process, the distributed speech recognition process being one in which speech recognition parameters are arranged in vectors corresponding to sampling time-frames and said speech recognition parameters are received at a second location having been transmitted from a first location;
the method comprising the steps of:
identifying a group comprising one or more of said vectors which have undergone a transmission error; and
replacing one or more speech recognition parameters in the identified group of vectors.

2. A method according to claim 1, wherein said one or more speech recognition parameters in said identified group of vectors are replaced by respective replacement parameters determined by reference to one or more speech recognition parameters from a vector received after said identified group of vectors.

3. A method according to claim 1 or 2, wherein all the speech recognition parameters of each vector of said group are replaced by replacing the whole vectors, and each respective replaced whole vector is replaced by a copy of whichever of the preceding or following vector without error is closest in receipt order to the vector being replaced.

4. A method according to claim 3, wherein a mode of transmission and a mode of error detection are such that said identified group comprises a pair of consecutive vectors, such that the first vector of said pair is replaced by the second vector of a preceding vector without error and the second vector of said pair is replaced by the first vector of a following vector without error.

5. A method according to claim 1 or 2, wherein all the speech recognition parameters of each vector of said group are replaced by replacing the whole vectors, and each respective replaced whole vector is replaced by a vector determined by means of an interpolation technique.

6. A method according to claim 1 or 2, wherein determination of which speech recognition parameter or parameters are to be replaced is performed by predicting, from vectors received without error, a predicted value for each speech recognition parameter within said identified group of vectors, and replacing those speech recognition parameters within the identified group of vectors which are outside of a predetermined threshold relative to their respective predicted value.

7. A method according to claim 6, wherein if more than a specified number of speech recognition parameters within said identified group of vectors are outside of their respective predetermined thresholds then all the speech recognition parameters of said identified group of vectors are replaced.

8. A method according to claim 6 or 7, wherein the speech recognition parameters are replaced by the respective predicted values used in the step of determining which speech recognition parameters are to be replaced.

9. A method according to claim 6 or 7, wherein those speech recognition parameters which are within a predetermined threshold relative to their respective predicted value are compared with a set of reference vectors to find a best match vector from said set of reference vectors, and those speech recognition parameters which are outside of a predetermined threshold relative to their respective predicted value are replaced by corresponding speech recognition parameters from said best match vector.

10. A method according to claim 9, wherein speech recognition parameters from one or more neighbouring vectors are also compared with the set of reference vectors and the best match with respect to a plurality of consecutive reference vectors is chosen.

11. A method according to any preceding claim, wherein said step of identifying a group comprising one or more of said vectors which have undergone a transmission error includes a step of predicting respective predicted values for said speech recognition parameters, determining one or more threshold levels relative to the predicted values, and identifying vector groups as having undergone a transmission error responsive to a weighted analysis of

how many speech recognition parameters in a vector group are outside of each of said one or more threshold levels.

12. A method according to any of claims 1-10, wherein said step of identifying a group comprising one or more of said vectors which have undergone a transmission error includes a step of determining a difference between corresponding speech recognition parameters from different vectors within a vector group, and identifying a vector group having undergone a transmission error responsive to an analysis of how many of said differences are outside of a predetermined threshold level.

13. An apparatus for mitigating errors in a distributed speech recognition process, the distributed speech recognition process being one in which speech recognition parameters are arranged in vectors corresponding to sampling time-frames and said speech recognition parameters are received at a second location having been transmitted from a first location;
the apparatus comprising:
means for identifying a group comprising one or more of said vectors which have undergone a transmission error; and
means for replacing one or more speech recognition parameters in the identified group of vectors.

14. An apparatus according to claim 13, wherein said one or more speech recognition parameters in said identified group of vectors are replaced by respective replacement parameters determined by reference to one or more speech recognition parameters from a vector received after said identified group of vectors.

15. An apparatus according to claim 13 or 14, wherein all the speech recognition parameters of each vector of said group are replaced by replacing the whole vectors, and each respective replaced whole vector is replaced by a copy of whichever of the preceding or following vector without error is closest in receipt order to the vector being replaced.

16. An apparatus according to claim 15, wherein a mode of transmission and a mode of error detection are such that said identified group comprises a pair

of consecutive vectors, such that the first vector of said pair is replaced by the second vector of a preceding vector without error and the second vector of said pair is replaced by the first vector of a following vector without error.

17. An apparatus according to claim 13 or 14, wherein all the speech recognition parameters of each vector of said group are replaced by replacing the whole vectors, and each respective replaced whole vector is replaced by a vector determined by means of an interpolation technique.

18. An apparatus according to claim 13 or 14, wherein determination of which speech recognition parameter or parameters are to be replaced is performed by predicting, from vectors received without error, a predicted value for each speech recognition parameter within said identified group of vectors, and replacing those speech recognition parameters within the identified group of vectors which are outside of a predetermined threshold relative to their respective predicted value.

19. An apparatus according to claim 18, wherein if more than a specified number of speech recognition parameters within said identified group of vectors are outside of their respective predetermined thresholds then all the speech recognition parameters of said identified group of vectors are replaced.

20. An apparatus according to claim 18 or 19, wherein the speech recognition parameters are replaced by the respective predicted values used in the step of determining which speech recognition parameters are to be replaced.

21. An apparatus according to claim 18 or 19, wherein those speech recognition parameters which are within a predetermined threshold relative to their respective predicted value are compared with a set of reference vectors to find a best match vector from said set of reference vectors, and those speech recognition parameters which are outside of a predetermined threshold relative to their respective predicted value are replaced by corresponding speech recognition parameters from said best match vector.

22. An apparatus according to claim 21, wherein speech recognition parameters from one or more neighbouring vectors are also compared with the set of reference vectors and the best match with respect to a plurality of consecutive reference vectors is chosen.

23. An apparatus according to any of claims 13-22, wherein said means for identifying a group comprising one or more of said vectors which have undergone a transmission error includes means for predicting respective predicted values for said speech recognition parameters, means for determining one or more threshold levels relative to the predicted values, and means for identifying vector groups as having undergone a transmission error responsive to a weighted analysis of how many speech recognition parameters in a vector group are outside of each of said one or more threshold levels.

24. An apparatus according to any of claims 13-22, wherein said means for identifying a group comprising one or more of said vectors which have undergone a transmission error includes means for determining a difference between corresponding speech recognition parameters from different vectors within a vector group, and means for identifying a vector group having undergone a transmission error responsive to an analysis of how many of said differences are outside of a predetermined threshold level.

25. An apparatus according to any of claims 13-24, wherein said speech recognition parameters are transmitted from said first location to said second location over a radio communications link.

26. A method according to any of claims 1-12, wherein said speech recognition parameters are transmitted from said first location to said second location over a radio communications link.

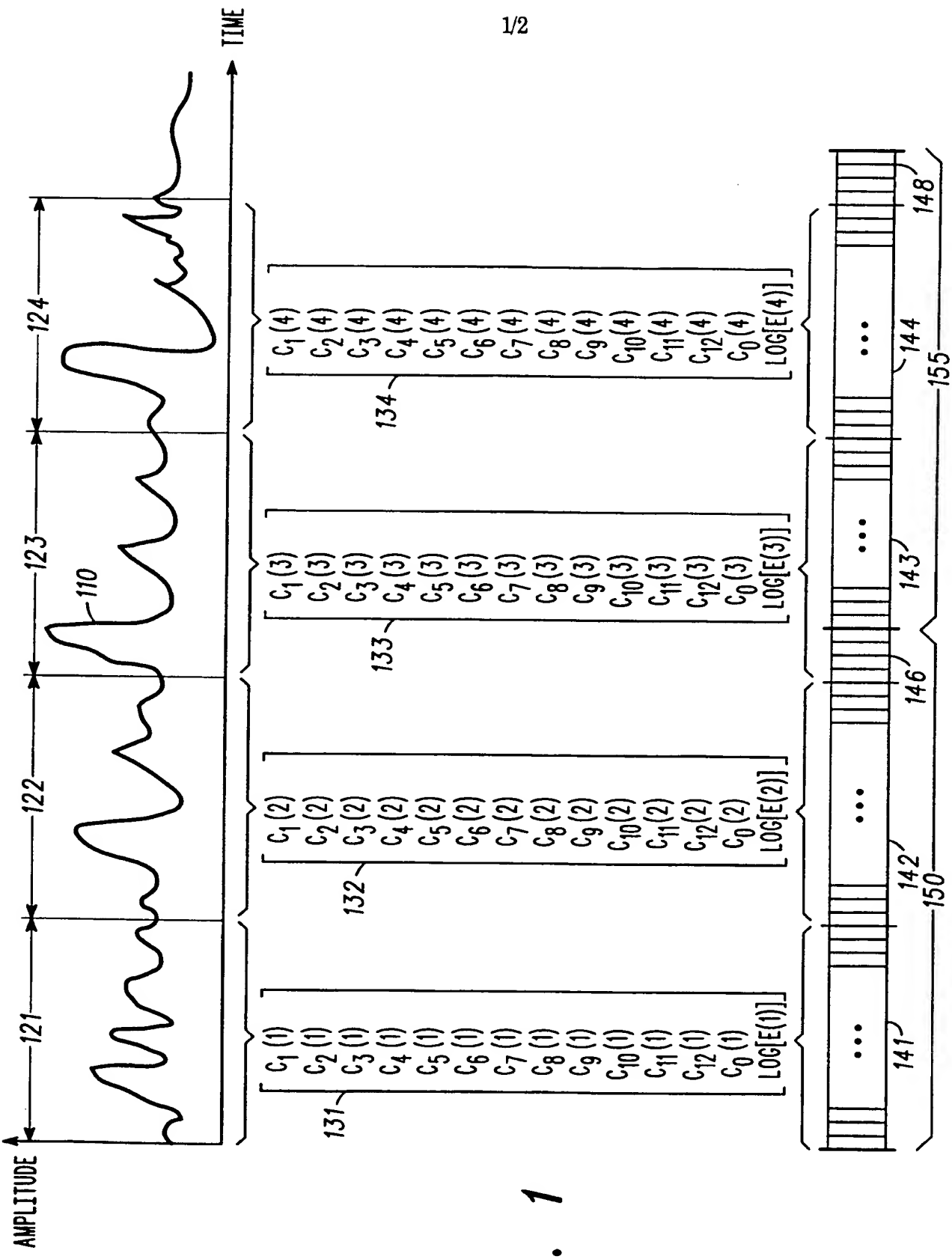
AMPLITUDE
TIME
110
121
122
123
124
131
132
133
134
141
142
143
144
146
148
150
155
LOG[E(1)]
LOG[E(2)]
LOG[E(3)]
LOG[E(4)]

FIG. 1

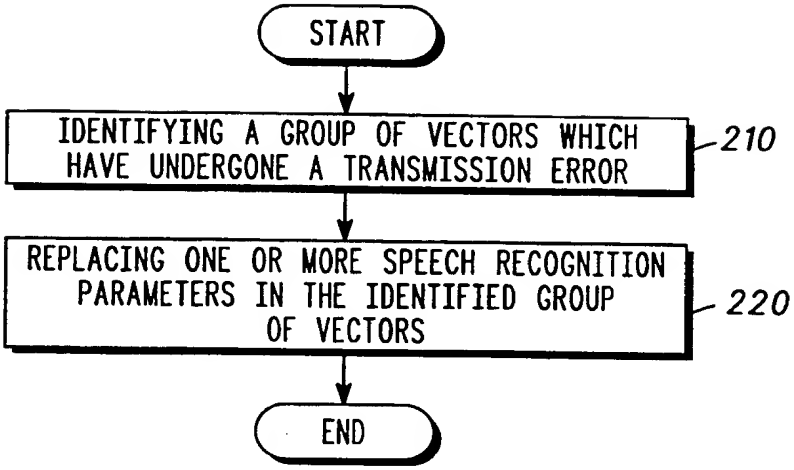
START
IDENTIFYING A GROUP OF VECTORS WHICH HAVE UNDERGONE A TRANSMISSION ERROR
210
REPLACING ONE OR MORE SPEECH RECOGNITION PARAMETERS IN THE IDENTIFIED GROUP OF VECTORS
220
END
200

FIG. 2

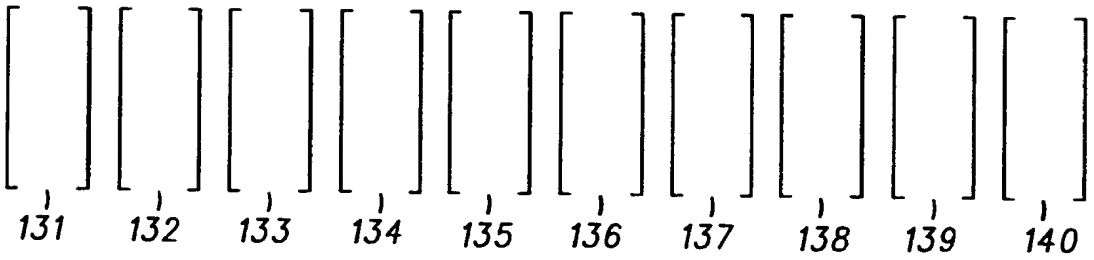
131
132
133
134
135
136
137
138
139
140

FIG. 3

INTERNATIONAL SEARCH REPORT

Int. ..tional Application No
PCT/EP 99/09028

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G10L15/26

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G10L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 459 358 A (NIPPON ELECTRIC CO) 4 December 1991 (1991-12-04) abstract page 2, line 57 -page 5, column 50; figures 1-4	1-3,5-8, 11-15, 17-21, 23-26
X	WO 96 27183 A (NOKIA TELECOMMUNICATIONS OY ;VAINIO JANNE (FI)) 6 September 1996 (1996-09-06) abstract page 11, line 11 - line 19 page 15, line 17 -page 19, line 2 page 21, line 3 - line 29 figures 1-6	1,3,5, 13,15, 17,25,26

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 February 2000	18/02/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Wanzeele, R

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

Int tional Application No
PCT/EP 99/09028

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0459358 A	04-12-1991	JP 4030200 A	03-02-1992
		DE 69113866 D	23-11-1995
		DE 69113866 T	18-04-1996
		US 5305332 A	19-04-1994
WO 9627183 A	06-09-1996	FI 950917 A	29-08-1996
		AU 701526 B	28-01-1999
		AU 4721496 A	18-09-1996
		CA 2210899 A	06-09-1996
		CN 1176703 A	18-03-1998
		EP 0812453 A	17-12-1997
		JP 10505987 T	09-06-1998
		NO 973941 A	27-10-1997

nil

15

PATENT COOPERATION TREATY

REC'D 15 NOV 2000
WIPO PCT

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
CM00620P/PCT		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/EP99/09028	12/11/1999	13/11/1998
International Patent Classification (IPC) or national classification and IPC G10L15/26		
Applicant MOTOROLA LIMITED et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 5 sheets, including this cover sheet.

   ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☒ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
09/06/2000	13.11.2000
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Bourdier, R Telephone No. +49 89 2399 2130

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/EP99/09028

I. Basis of the report

1. This report has been drawn on the basis of *(substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments (Rules 70.16 and 70.17).)*:
Description, pages:

1-17 as originally filed

Claims, No.:

1-26 as originally filed

Drawings, sheets:

1/2-2/2 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	3,4,6-12,15,16,18-24
	No:	Claims	1,2,5,13,14,17,25,26
Inventive step (IS)	Yes:	Claims	6-12,18-24
	No:	Claims	3,4,15,16
Industrial applicability (IA)	Yes:	Claims	1-26
	No:	Claims	

2. Citations and explanations
see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

TO SECTION V

1. The closest prior art for the present application is considered to be EP-A-0 459 358, referred to as D1 in the following.

   D1 discloses a speech decoder with an error correction decoding circuit. This circuit, suitable for use at the reception of a radio transmission path, detects a transmission error in the received code string. In case an error has been detected, an interpolation circuit interpolates between parameters of past and future proper frames, thereby recovering parameters of the current frame. This algorithm applies to at least 2 parameters. See D1, abstract, page 2, lines 1-2 and page 4, lines 8-19, page 5, lines 37-39.

2. In view of the teaching of D1, the subject matter of the independent claims 1 (method) and 13 (apparatus) lacks novelty.

   It is noted that D1 does not mention the idea of ranging parameters into "vectors", as claimed in claims 1 and 13. However, it is clear from the description, page 8, line 27 to page 9, line 7, that in the present application, the "vectors" merely stand for an abstract representation of the data (parameters) contained in a bit stream: the actual error detection and parameter replacement in D1 and in the application are identical.

3. The lack of novelty extends also to claims 2,5 and 26 respectively 14, 17 and 25.

4. The additional features of claim 3,4 and 15,16 relative to replacing of an erroneous vector by a copy of an errorless vector is considered to be a trivial case of what is claimed in claim 2, respectively in claim 15. Therefore, the subject matter of these claims is not considered to involve an inventive step.

5. The additional features of claims 6, 11 and 12, respectively 18, 23 and 24 relative the detection of the parameters to be replaced are neither known nor considered obvious, so that these claims, in combination with the claims they are made dependent from, are considered to be novel and inventive.

This also applies to the dependent claims 7-10 and 19-22.

6. All claims are obviously susceptible of industrial applicability

TO SECTION VII

1. Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the document D1 is not mentioned in the description, nor is this document identified therein.

PCT REQUEST

For receiving Office use only

International Application No.

International Filing Date

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference *(if desired)(12 characters maximum)* CM00620P/PCT

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

Box No. I **TITLE OF INVENTION:** MITIGATING ERRORS IN A DISTRIBUTED SPEECH RECOGNITION PROCESS

Box No. II **APPLICANT**

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

Motorola Limited
Jays Close
Viables Industrial Estate
Basingstoke, Hampshire, RG22 4PD

☐ This person is also inventor.

Telephone No.

Facsimile No.

Teleprinter No.

State *(i.e. country)* of nationality: GB

State *(i.e. country)* of residence: GB

This person is applicant for the purposes of: ☐ all designated States ☒ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

Box No. III **FURTHER APPLICANTS AND/OR (FURTHER) INVENTORS**

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

PEARCE, David John Benjamin
7 Pyotts Copse
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Basingstoke
Hampshire, RG24 8WE

This person is:

☐ applicant only

☒ applicant and inventor

☐ inventor only *(if this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality: GB

State *(i.e. country)* of residence: GB

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

☐ Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV **AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE**

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☒ agent ☐ common representative

Name and address: *(Family name followed by given name: for a legal entity, full official designation. The address must include postal code and name of country)*

HUDSON, Peter
Motorola, European Intellectual Property Operations
Midpoint, Alencon Link
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Hampshire, RG21 7PL

Telephone No.
01256 790 790

Facsimile No.
01256 811 319

Teleprinter No.

☐ **Address for correspondence:** Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

Continuation of Box No. III FURTHER APPLICANTS AND/OR (FURTHER) INVENTORS

If none of the following sub-boxes is used, this sheet is not to be included in the request.

Name and address: *(Family name followed by given name: for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

GIBBS, Jon Alastair
48 Stanier Way
Hedge End
Southampton
Hampshire, SO30 2XF

This person is:

- [ ] applicant only
- [X] applicant and inventor
- [ ] inventor only *(if this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality: GB

State *(i.e. country)* of residence: GB

This person is applicant for the purposes of: [ ] all designated States [ ] all designated States except the United States of America [X] the United States of America only [ ] the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name: for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

This person is:

- [ ] applicant only
- [ ] applicant and inventor
- [ ] inventor only *(if this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality:

State *(i.e. country)* of residence:

This person is applicant for the purposes of: [ ] all designated States [ ] all designated States except the United States of America [ ] the United States of America only [ ] the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name: for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

This person is:

- [ ] applicant only
- [ ] applicant and inventor
- [ ] inventor only *(if this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality:

State *(i.e. country)* of residence:

This person is applicant for the purposes of: [ ] all designated States [ ] all designated States except the United States of America [ ] the United States of America only [ ] the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name: for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

This person is:

- [ ] applicant only
- [ ] applicant and inventor
- [ ] inventor only *(if this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality:

State *(i.e. country)* of residence:

This person is applicant for the purposes of: [ ] all designated States [ ] all designated States except the United States of America [ ] the United States of America only [ ] the States indicated in the Supplemental Box

[ ] Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No.V DESIGNATION OF STATES

The following designations are hereby made under Rule 4.9(a) *(mark the applicable check-boxes; at least one must be marked)*:

Regional Patent

- ☐ **AP** **ARIPO Patent:** GH Ghana, GM Gambia, KE Kenya, LS Lesotho, MW Malawi, SD Sudan, SL Sierra Leone, SZ Swaziland, UG Uganda, ZW Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT
- ☐ **EA** **Eurasian Patent:** AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakhstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT
- ☒ **EP** **European Patent:** AT Austria, BE Belgium, CH and LI Switzerland and Liechtenstein, CY Cyprus, DE Germany, DK Denmark, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- ☐ **OA** **OAPI Patent:** BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, GW Guinea-Bissau, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT *(if other kind of protection or treatment desired, specify on dotted line)* .....

National Patent *(if other kind of protection or treatment desired, specify on dotted line)*:

- ☒ **AE** United Arab Emirates
- ☒ **AL** Albania .....
- ☒ **AM** Armenia .....
- ☒ **AT** Austria .....
- ☒ **AU** Australia .....
- ☒ **AZ** Azerbaijan
- ☒ **BA** Bosnia and Herzegovina .....
- ☒ **BB** Barbados
- ☒ **BG** Bulgaria .....
- ☒ **BR** Brazil .....
- ☒ **BY** Belarus .....
- ☒ **CA** Canada
- ☒ **CH and LI** Switzerland and Liechtenstein
- ☒ **CN** China .....
- ☒ **CU** Cuba .....
- ☒ **CZ** Czech Republic .....
- ☒ **DE** Germany .....
- ☒ **DK** Denmark .....
- ☒ **EE** Estonia .....
- ☒ **ES** Spain .....
- ☒ **FI** Finland .....
- ☒ **GB** United Kingdom
- ☒ **GD** Grenada
- ☒ **GE** Georgia .....
- ☒ **GH** Ghana .....
- ☒ **GM** Gambia
- ☒ **HR** Croatia .....
- ☒ **HU** Hungary .....
- ☒ **ID** Indonesia
- ☒ **IL** Israel .....
- ☒ **IN** India .....
- ☒ **IS** Iceland
- ☒ **JP** Japan .....
- ☒ **KE** Kenya .....
- ☒ **KG** Kyrgyzstan .....
- ☒ **KP** Democratic People's Republic of Korea .....
- ☒ **KR** Republic of Korea .....
- ☒ **KZ** Kazakhstan .....
- ☒ **LC** Saint Lucia
- ☒ **LK** Sri Lanka
- ☒ **LR** Liberia
- ☒ **LS** Lesotho .....
- ☒ **LT** Lithuania
- ☒ **LU** Luxembourg
- ☒ **LV** Latvia
- ☒ **MD** Republic of Moldova .....
- ☒ **MG** Madagascar .....
- ☒ **MK** The former Yugoslav Republic of Macedonia .....
- ☒ **MN** Mongolia
- ☒ **MW** Malawi .....
- ☒ **MX** Mexico .....
- ☒ **NO** Norway
- ☒ **NZ** New Zealand .....
- ☒ **PL** Poland .....
- ☒ **PT** Portugal .....
- ☒ **RO** Romania
- ☒ **RU** Russian Federation .....
- ☒ **SD** Sudan
- ☒ **SE** Sweden
- ☒ **SG** Singapore
- ☒ **SI** Slovenia .....
- ☒ **SK** Slovakia .....
- ☒ **SL** Sierra Leone .....
- ☒ **TJ** Tajikistan .....
- ☒ **TM** Turkmenistan .....
- ☒ **TR** Turkey .....
- ☒ **TT** Trinidad and Tobago .....
- ☒ **UA** Ukraine .....
- ☒ **UG** Uganda .....
- ☒ **US** United States of America .....
- ☒ **UZ** Uzbekistan .....
- ☒ **VN** Viet Nam .....
- ☒ **YU** Yugoslavia .....
- ☒ **ZA** South Africa .....
- ☒ **ZW** Zimbabwe .....

Check-boxes reserved for designating States which have become party to the PCT after issuance of this sheet:

- ☐ .....
- ☐ .....

Precautionary Designation Statement: In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. *(Confirmation of a designation consists of the filing of a notice specifying that designation and the payment of the designation and confirmation fees. Confirmation must reach the receiving Office within the 15-month time limit.)*

Supplemental Box *If the Supplemental Box is not used, this sheet should not be included in the request.*

1. If, in any of the Boxes, the space is insufficient to furnish all the information: in such case, write "Continuation of Box No. ..." [indicate the number of the Box] and furnish the information in the same manner as required according to the instructions of the Box in which the space was insufficient, in particular:

*(i) **if more than two persons are involved as applicants and/or inventors** and no "continuation sheet" is available: in such case, write "Continuation of Box No. III" and indicate for each additional person the same type of information as required in Box No. III. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below;*

*(ii) if, in Box No. II or in any of the sub-boxes of Box No. III, the indication **"the States indicated in the Supplemental Box"** is checked: in such case, write "Continuation of Box No. II" or "Continuation of Box No. III" or "Continuation of Boxes No. II and No. III" (as the case may be), indicate the name of the applicant(s) involved and, next to (each) such name, the State(s) (and/or, where applicable, ARIPO, Eurasian, European or OAPI patent) for the purposes of which the named person is applicant;*

*(iii) if, in Box No. II or in any of the sub-boxes of Box No. III, **the inventor or the inventor/applicant is not inventor for the purposes of all designated States or for the purposes of all designated States of America**: in such case, write "Continuation of Box No. II" or "Continuation of Box No. III" or Continuation of Boxes No. II and No. III" (as the case may be), indicate the name of the inventor(s) and, next to (each) such name, the State(s) (and/or, where applicable, ARIPO, Eurasian, European or OAPI patent) for the purposes of which the named person is inventor;*

*(iv) if, in addition to the agent(s) indicated in Box No. IV, there are **further agents**: in such case, write "Continuation of Box No. IV" and indicate for each further agent the same type of information as required in Box No. IV;*

*(v) if, in Box No. V, the name of any State (or OAPI) is accompanied by the indication **"patent of addition,"** or **"certificate of addition,"** or if, in Box No. V, the name of the United States of America is accompanied by an indication **"continuation"** or **"Continuation-in-part"**: in such case, write "Continuation of Box No. V" and the name of each State involved (or OAPI), and after the name of each such State (or OAPI), the number of the parent title or parent application and the date of grant of the parent title or filing of the parent application;*

*(vi) if, in Box No. VI, **there are more that three earlier applications whose priority is claimed**: in such case, write "Continuation of Box No. VI" and indicate for each additional earlier application the same type of information as required in Box No. VI.*

*(vii) if, in Box No. VI, **the earlier application is an ARIPO application**: in such case, write "Continuation of Box No VI", specify the number of the item corresponding to that earlier application and indicate at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed.*

*2. If, with regard to the **precautionary designation statement** contained in Box No. V. the applicant wishes to exclude any State(s) from the scope of that statement: in such case, write "Designation(s) excluded from precautionary designation statement" and indicate the name or two-letter code of each State so excluded*

*3. If the applicant claims, in respect of any designated Office, the benefits of provisions of the national law concerning **non-prejudicial disclosures or exceptions to lack of novelty**: in such case, write "Statement concerning non-prejudicial disclosures or exceptions to lack of novelty" and furnish that statement below*

Continuation of Box No. IV

IBBOTSON, Harry
GIBSON, Sarah
POTTS, Susan
TRELEVEN, Colin
HUDSON, Peter

All above attorneys/agents are members of Motorola, Inc., Intellectual Property Department and have the same address, telephone number and telegraphic address as indicated in Box IV.

Box No. VI PRIORITY CLAIM Further priority claims are indicated in the Supplemental Box ☐

Priority of the following earlier application(s) is claimed:

Filing Date of earlier application *(day/month/year)*	Number of earlier application	Office where earlier application filed: National application = country; regional application = regional Office	International application = receiving Office
item (1) 13 November 1998 (13.11.98)	9824894.1	United Kingdom	
item (2)			
item (3)			

☐ The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) *(only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office)* identified above as item(s):_____

* *Where the earlier application is an ARIPO application, it is mandatory to indicate in the Supplemental Box at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed (Rule 4.10(b)(ii). See Supplemental Box.*

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) *(if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):* ISA/ EP

Request to use results of earlier search; reference to that search *(if an earlier search has been carried out by or requested from the International Searching Authority):*

Date *(day/month/year)* Number: Country (or regional office):

Box No. VIII CHECK LIST; LANGUAGE OF FILING

This international application contains the following **number of sheets**:

1. request	5	sheets
2. description (excluding sequence listing part)	17	sheets
3. claims	5	sheets
4. abstract	1	sheets
5. drawings	3	sheets
6. sequence listing part of description		sheets
Total	31	sheets

This international application is **accompanied by** the item(s) marked below:

1. ☒ fee calculation sheet
2. ☐ separate signed power of attorney
3. ☒ copy of general power of attorney
4. ☐ statement explaining lack of signature
5. ☐ priority document(s) identified in Box No. VI as item(s):
6. ☐ translation of international application into (language):_____
7. ☐ separate indications concerning deposited microorgs./biological mat.
8. ☐ nucleotide and/or amino acid sequence listing in computer readable form
9. ☐ other *(specify)*: copy, U.S. assignment

Figure No. 1 of the drawings (if any) should accompany the abstract when it is published.

Language of filing of the international application: EN

Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

Peter D. Hudson

PETER HUDSON - AGENT

For receiving Office use only

1. Date of actual receipt of the purported international application:
2. Drawings: ☐ received: ☐ not received:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:
4. Date of timely receipt of the required corrections under PCT Article II(2):
5. International Searching Authority specified by the applicant: ISA/
6. ☐ Transmittal of search copy delayed until search fee is paid

For International Bureau use only

Date of receipt of the record copy by the International Bureau:

This sheet is not part of and does not count as a sheet of the international application.

PCT
FEE CALCULATION SHEET
Annex to the Request

International application No.

Applicant's or agent's file reference CM00620P/PCT

Date Stamp of the receiving Office

Applicant MOTOROLA LIMITED

CALCULATION OF PRESCRIBED FEES

1. TRANSMITTAL FEE 199.49 [T]

2. SEARCH FEE 2198.35 [S]

International search to be carried out by ISA/ EP
(If two or more International Searching Authorities are competent in relation to the international application, indicate the name of the Authority which is chosen to carry out the international search.)

3. INTERNATIONAL FEE

Basic Fee

The international application contains 31 sheets.

first 30 sheets 807.76 [b_1]

1 (remaining sheets) X 19.56 (additional amount) = 19.56 [b_2]

Add amounts entered at b_1 and b_2 and enter total at B 827.32 [B]

Designation Fees

10 (number of designations payable (maximum 10)) X 185.80 (amount of designation fee) 1858.00 [D]

Add amounts entered at B and D and enter total as I 2685.32 [I]

(Applicants from certain States are entitled to a reduction of 75% of the international fee. Where the applicant is (or all applicants are) so entitled the total to be entered at I is 25% of the sum of the amounts entered at B and D.)

4. FEE FOR PRIORITY DOCUMENT *(if applicable)* 0.00 [P]

5. TOTAL FEES PAYABLE

Add amounts entered at T, S, I and P, and enter total in the TOTAL box 5083.31

TOTAL

☐ The designation fees are not paid at this time.

MODE OF PAYMENT

[X]	authorization to charge deposit account (see below)	☐	bank draft	☐	coupons
☐	cheque	☐	cash	☐	other *(specify):*
☐	postal money order	☐	revenue stamps		

DEPOSIT ACCOUNT AUTHORIZATION

The RO/ EP

[X] is hereby authorized to charge the total fees indicated above to my deposit account

[X] is hereby authorized to charge any deficiency or credit any overpayment in the total fees indicated above to my deposit account.

[X] is hereby authorized to charge the fee for preparation and transmittal of the priority document to the International Bureau of WIPO to my deposit account.

28050071	12 November 1999	Peter D. Hudson
Deposit Account Number	Date *(day/month/year)*	Signature HUDSON, PETER

See Notes to the fee calculation sheet

Bitte die 3 Blätter 1004.1-3 dem EPA übermitteln
Please forward the 3 sheets 1004.1-3 to the EPO
Prière de faire parvenir les 3 feuilles 1004.1 à 3 à l'OEB

ALLGEMEINE VOLLMACHT
GENERAL AUTHORISATION
POUVOIR GENERAL

Bitte die Bemerkungen zu den Randnummern beachten (Blatt 1004.4)
Please pay attention to the notes regarding the marginal numbers (sheet 1004.4)
Prière de tenir compte des remarques concernant les nos en marge (feuille 1004.4)

Nur für amtlichen Gebrauch / For official use only
Cadre réservé à l'administration
Nr. der allgemeinen Vollmacht / General Authorisation No.
N° du pouvoir général

9987

2 Ich (Wir) / I (We) / Je (Nous)

MOTOROLA LTD
JAYS CLOSE, VIABLES INDUSTRIAL ESTATE
BASINGSTOKE, HAMPSHIRE RG22 4PD
UNITED KINGDOM

bevollmächtige(n) hiermit / do hereby authorise / autorise (autorisons) par la présente

HUDSON, PETER DAVID
MOTOROLA INC
PATENT & LICENSING OPERATIONS - EUROPE
JAYS CLOSE, VIABLES INDUSTRIAL ESTATE
BASINGSTOKE, HAMPSHIRE RG22 4PD
UNITED KINGDOM

Telephone : (0256) 58211

Telex: 858823

~~+ Hirsz 24.12.87~~ del. 16.05.89 (see new gen. auth. in favour of Hirsz dated 12.12.94)

mich (uns) in den durch das Europäische Patentübereinkommen geschaffenen Verfahren in allen meinen (unseren) Patentangelegenheiten zu vertreten, alle Handlungen für mich (uns) vorzunehmen und Zahlungen für mich (uns) in Empfang zu nehmen.
to represent me (us) in all proceedings established by the European Patent Convention and to act for me (us) in all patent transactions and to receive payments on my (our) behalf.
à me (nous) représenter pour ce qui concerne toutes mes (nos) affaires de brevet dans toute procédure instituée par la Convention sur le brevet européen et, à ce titre, à agir en mon (notre) nom et à recevoir des paiements pour mon (notre) compte.

☒ Die Vollmacht gilt auch für Verfahren nach dem Vertrag über die internationale Zusammenarbeit auf dem Gebiet des Patentwesens.
This authorisation shall also apply to the same extent to any proceedings established by the Patent Cooperation Treaty.
Ce pouvoir s'applique également à toute procédure instituée par le Traité de coopération en matière de brevets.

☐ Weitere Vertreter sind auf einem gesonderten Blatt angegeben. / Additional representatives indicated on supplementary sheet.
Les autres mandataires sont mentionnés sur une feuille supplémentaire.

5 ☒ Untervollmacht kann erteilt werden. / Sub-authorisation may be given. / Substitution pourra être faite. JM 6/5

6 ☐ Bitte die gelbe Kopie, ergänzt um die Nr. der allgemeinen Vollmacht, an den Vollmachtgeber zurücksenden.
Please return the yellow copy, supplemented by the General Authorisation No., to the authorisor.
Prière de renvoyer la copie jaune au mandant, munie du n° du pouvoir général.

Ort / Place / Lieu BASINGSTOKE, U.K.

Datum / Date 20.06.84

Unterschrift(en) / Signature(s)

FOR MOTOROLA LTD
THEIR ATTORNEY

MOTOROLA LIMITED
by
HAROLD IBBOTSON
H. IBBOTSON (Signature)
their Attorney

7 Das Formblatt muß vom (von den) Vollmachtgeber(n) (bei juristischen Personen vom Unterschriftsberechtigten) eigenhändig unterzeichnet sein. Nach der Unterschrift bitte den (die) Namen des (der) Unterzeichneten mit Schreibmaschine wiederholen (bei juristischen Personen die Stellung des Unterschriftsberechtigten innerhalb der Gesellschaft angeben).

The form must bear the personal signature(s) of the authorisor(s) (in the case of legal persons, that of the officer empowered to sign). After the signature, please type the name(s) of the signatory(ies) adding, in the case of legal persons, his (their) position within the company.

Le formulaire doit être signé de la propre main du (des) mandant(s) (dans le cas de personnes morales, de la personne ayant qualité pour signer). Veuillez ajouter à la machine, après la signature, le (les) nom(s) du (des) signataire(s) en mentionnant, dans le cas de personnes morales, ses (leurs) fonctions au sein de la société.

A 23.02.89

1. Appointment of Representative

Ibbotson, Harold

Motorola Limited
European Intellectual Property Operations
Jays Close
Viables Industrial Estate
Basingstoke
Hampshire
RG22 4PD

and

2. Appointment of Representative

Hudson, Peter David

Motorola Limited
European Intellectual Property Operations
Jays Close
Viables Industrial Estate
Basingstoke
Hampshire
RG22 4PD

Mr Hudson is already main-authorised

QL

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	FOR FURTHER ACTION	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
CM00620P/PCT		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/EP 99/09028	12/11/1999	13/11/1998
Applicant		
MOTOROLA LIMITED et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 2 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

   a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

   [ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

   b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

   [ ] contained in the international application in written form.

   [ ] filed together with the international application in computer readable form.

   [ ] furnished subsequently to this Authority in written form.

   [ ] furnished subsequently to this Authority in computer readble form.

   [ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   [ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. [ ] **Certain claims were found unsearchable** (See Box I).

3. [ ] **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. 1

   [X] as suggested by the applicant.

   [ ] None of the figures.

   [ ] because the applicant failed to suggest a figure.

   [ ] because this figure better characterizes the invention.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 99/09028

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G10L15/26

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G10L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 459 358 A (NIPPON ELECTRIC CO) 4 December 1991 (1991-12-04) abstract page 2, line 57 -page 5, column 50; figures 1-4	1-3,5-8, 11-15, 17-21, 23-26
X	WO 96 27183 A (NOKIA TELECOMMUNICATIONS OY ;VAINIO JANNE (FI)) 6 September 1996 (1996-09-06) abstract page 11, line 11 - line 19 page 15, line 17 -page 19, line 2 page 21, line 3 - line 29 figures 1-6	1,3,5, 13,15, 17,25,26

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 February 2000	18/02/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Wanzeele, R

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/EP 99/09028

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0459358 A	04-12-1991	JP 4030200 A	03-02-1992
		DE 69113866 D	23-11-1995
		DE 69113866 T	18-04-1996
		US 5305332 A	19-04-1994
WO 9627183 A	06-09-1996	FI 950917 A	29-08-1996
		AU 701526 B	28-01-1999
		AU 4721496 A	18-09-1996
		CA 2210899 A	06-09-1996
		CN 1176703 A	18-03-1998
		EP 0812453 A	17-12-1997
		JP 10505987 T	09-06-1998
		NO 973941 A	27-10-1997

P ENT COOPERATION TREAT

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Assistant Commissioner for Patents
United States Patent and Trademark Office
Box PCT
Washington, D.C.20231
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 17 July 2000 (17.07.00)	
International application No. PCT/EP99/09028	**Applicant's or agent's file reference** CM00620P/PCT
International filing date (day/month/year) 12 November 1999 (12.11.99)	**Priority date** (day/month/year) 13 November 1998 (13.11.98)
Applicant PEARCE, David, John, Benjamin et al	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

09 June 2000 (09.06.00)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer Manu Berrod
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38